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TECHNICAL REPORT NO. 68-23

OPERATION OF THE UINTA BASIN SEISMOLOGICAL OBSERVATORY, QUARTERLY REPORT NO. 8

1 February 1968 through 30 April 1968

GEOTECH
A TELEDYNE COMPANY

TECHNICAL REPORT NO. 68-23

OPERATION OF THE UINTA BASIN SEISMOLOGICAL OBSERVATORY, QUARTERLY REPORT NO. 8
1 February 1968 through 30 April 1968

Sponsored by

Advanced Research Projects Agency
Nuclear Test Detection Office
ARPA Order No. 624

GEOTECH
A TELEDYNE COMPANY
3401 Shiloh Road
Garland, Texas

3 June 1968

IDENTIFICATION

AFTAC Project No:	VELA T/6705
Project Title:	Operation of UBSO
ARPA Order No:	624
ARPA Program Code No:	6F10
Name of Contractor:	Teledyne Industries, Geotech Division
Date of Contract:	1 May 1966
Amount of Contract and Amendment 1:	$ 624,897
Amount of Amendment 2:	$ 374,600
Contract Change Notice No. 1 (not negotiated)	$ 86,000
Total	$1,085,497
Contract No:	AF 33(657)-16563
Contract Expiration Date:	31 October 1968
Program Manager:	B. B. Leichliter, BR1-2561, Ext. 222

ABSTRACT

This report describes the operations of the Uinta Basin Seismological Observatory (UBSO) from 1 February 1968 through 30 April 1968. Modifications and additions to the observatory instrumentation are described, and tests to improve the operations of the observatory are reported. Also discussed is the status of special investigations designed to evaluate and improve the detection capability of the observatory.

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ILLUSTRATIONS

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OPERATION OF THE UINTA BASIN SEISMOLOGICAL OBSERVATORY,
QUARTERLY REPORT NO. 8
1 February 1968 through 30 April 1968

1. INTRODUCTION

1.1 AUTHORITY

The work described in this report was supported by the Advanced Research Projects Agency, Nuclear Test Detection Office, and was monitored by the Air Force Technical Applications Center (AFTAC), under Contract AF 33(657)-16563. The statement of work for this contract is shown in the appendix.

1.2 HISTORY

The Uinta Basin Seismological Observatory (UBSO) was constructed under Contract AF 33(657)-7185. Site selection and noise surveys were accomplished by Geotech; the final decision on the observatory location was made by AFTAC. Texas Instruments, Incorporated (TI) was responsible for the construction of all physical facilities.

Contract AF 33(600)-43486, issued to TI, contained the authority for equipping and operating UBSO. The instrumentation was supplied by Geotech and was installed under the direction of Geotech personnel under subcontract to TI. Texas Instruments operated the observatory from November 1962 until 1 July 1963. Under Projects VT/1124 and VT/5054, Contract AF 33(657)-12373, Geotech operated UBSO from 1 July 1963 through 30 April 1966.

2. OPERATION OF UBSO

2.1 GENERAL

Data are recorded at UBSO on a 24-hour basis. The observatory is normally manned 8 to 10 hours a day, 5 days a week. On weekends and holidays, a skeleton crew mans the observatory 8 hours a day; however, additional personnel are on call in case of emergency.

The UBSO array configuration is shown in figure 1.

The VT 6705 Project Officer and Mr. B. B. Leichliter, the Geotech Program Manager, visited UBSO on 2 February.

On 20 February, Mr. J. N. Robertson made a routine security inspection by telephone. UBSO security inspections will be conducted by telephone until such a time that we have classified documents at the observatory.

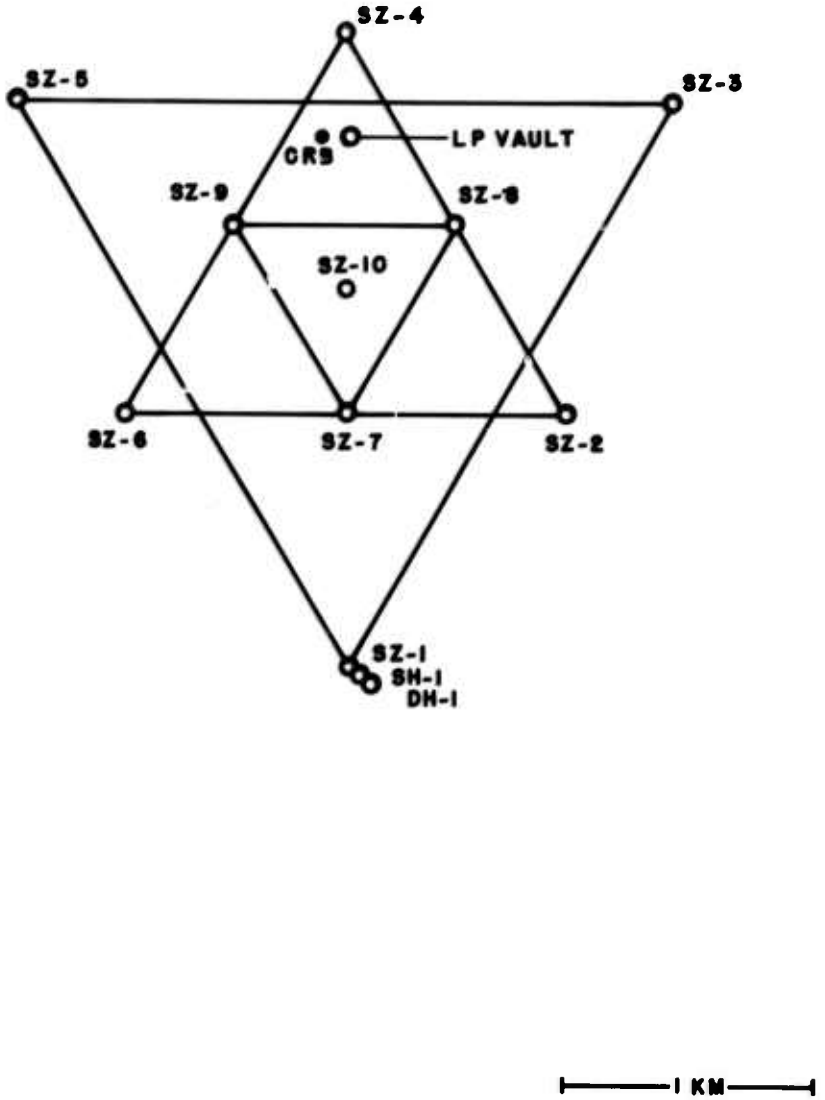

Figure 1. Orientation and configuration of UBSO arrays

2.2 SEISMOGRAPH OPERATING PARAMETERS

2.2.1 Standard Seismographs

The operating parameters and the tolerances for the standard observatory seismographs are shown in table 1. These parameters are reset if the frequency response of a seismograph is found to be out of tolerance. The frequency response norms and their respective tolerances are shown in table 2. The frequency responses of the UBSO seismographs, as normally operated, are shown in figure 2.

2.2.2 Filters for Shallow-Buried Array Summations

The summation of the ten-element shallow-buried array is filtered by a band-pass filter with the following settings: a high-cut corner frequency of 3 cps and a low-cut corner frequency of 0.8 cps, both at a cutoff rate of 18 dB per octave.

2.3 DATA CHANNEL ASSIGNMENTS

The current data-channel assignments and normal operating magnifications for all UBSO data groups are shown in table 3. The key to the designators used in the data-channel assignments is given in table 4.

2.4 SHIPMENT OF DATA TO THE SEISMIC DATA LABORATORY (SDL)

Magnetic-tape seismograms are shipped to SDL about 15 days after the end of the month during which they are recorded. The seismograms from magnetic-tape recorders 1, 2, 3, and 4 recorded at UBSO through March 1968 have been shipped to SDL.

All 16-millimeter film seismograms recorded at UBSO through February 1968 were sent to SDL. More recent films are currently held in Garland for special studies.

2.5 QUALITY CONTROL

Quality control checks were made on randomly selected runs of all recordings from the observatory. Results of the checks were sent to the observatory for corrective action, as necessary.

Table 1. Operating parameters and tolerances of seismographs at UBSO

Seismograph				Operating parameters and tolerances					Filter settings	
		Seismometer								
System	Comp	Type	Model	T_s	λ_s	T_g	λ_g	σ^2	Bandpass at 3 dB cutoff (sec)	Cut off rate at SP side (dB/oct)
SP	Z and H	Johnson-Matheson	7515 6480	1.25 ±2%	0.51 ±5%	0.33 ±5%	0.65 ±5%	0.03	0.1-100	12
SP	SZ	Geotech	18300	1.25 ±2%	0.51 ±5%	0.33 ±5%	0.65 ±5%	0.053	0.1-100	12
SP	Z	UA Benioff	1051	1.0 ±5%	1.0	0.083 ±5%	≈1.4	1.0	-	-
BB	Z	Geotech	7505	12.5 ±5%	0.485 ±5%	0.64 ±5%	9.0 ±5%	0.0007	0.05-100	12
BB	H	Geotech	8700A	12.5 ±5%	0.485	0.64 ±5%	9.0 ±5%	0.0007	0.05-100	12
LP	Z	Geotech	7505A	20.0 ±5%	0.74 ±5%	110 ±10%	0.85 ±10%	0.63	25-1000	12
LP	H	Geotech	8700A	20.0 ±5%	0.74 ±5%	110 ±10%	0.85 ±10%	0.63	25-1000	12

KEY

SP	Short period	T_s	Seismometer free period (sec)
BB	Broad band	T_g	Galvanometer free period (sec)
LP	Long period	λ_s	Seismometer damping constant
UA	Unamplified (i.e., earth powered)	λ_g	Galvanometer damping constant
		σ^2	Coupling coefficient

Table 2. Calibration norms and operating tolerances for frequency responses of the standard seismographs at UBSO

SP Vertical 18300 and SP Johnson-Matheson Vertical and Horizontal

f (cps)	T (sec)	R. M.	A. T. (±%)
0.2	5.0	0.0113	10
0.4	2.5	0.0950	7.5
0.8	1.25	0.685	5
1.0	1.0	1.0	-
1.5	0.67	1.52	5
2.0	0.5	1.90	5
3.0	0.33	2.12	7.5
4.0	0.25	1.87	12
6.0	0.167	1.15	20
8.0	0.125		
10.0	0.100		

LP1 Vertical and Horizontal (broad response)

f (cps)	T (sec)	R. M.	A. T. (±%)
0.01	100	0.262	20
0.0125	80	0.408	20
0.0167	60	0.595	15
0.02	50	0.720	15
0.025	40	0.870	10
0.033	30	1.01	5
0.04	25	1.0	-
0.05	20	0.822	5
0.0667	15	0.427	10
0.10	10	0.077	20

LP2 Vertical and Horizontal (narrow response)

f (cps)	T (sec)	R. M.	A. T. (±%)
0.01	100	0.063	20
0.0125	80	0.130	20
0.0167	60	0.257	15
0.02	50	0.380	15
0.025	40	0.586	10
0.033	30	0.903	5
0.04	25	1.0	0
0.05	20	0.810	5
0.0667	15	0.345	10
0.10	10	0.058	20

KEY

R. M. Relative magnification
A. T. Amplitude tolerance

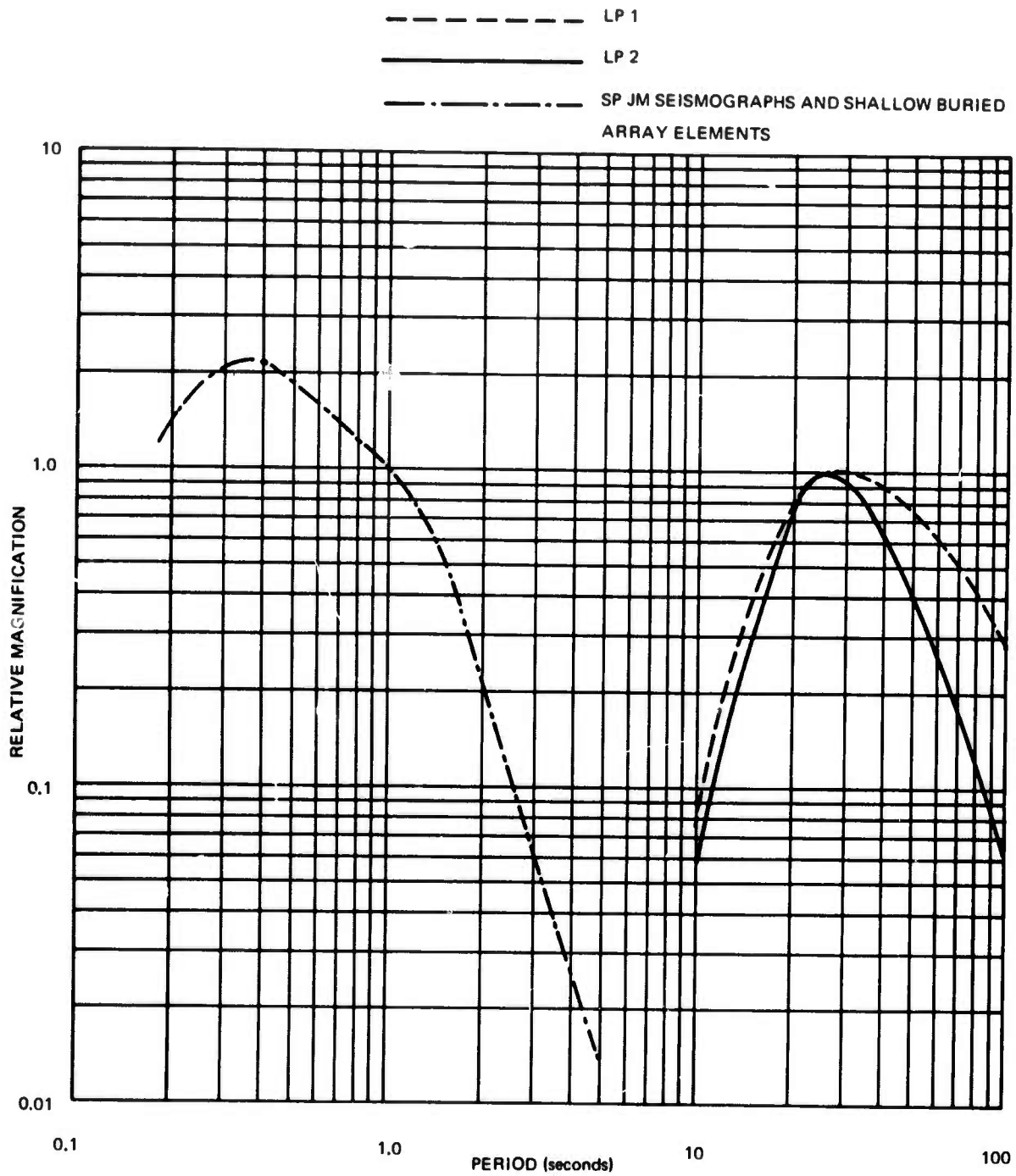

Figure 2. Normalized response characteristics of the standard seismographs at UBSO

G 4127

Table 3. Data channel assignments and normal operating magnifications at UBSO

DEVELOCORDERS

FAST SPEED 30mm/min.

DATA GROUP 5044 SP Primary

Channel	Trace	Mag.
1	V	20K
2	SZ1	600K
3	SZ3	600K
4	SZ5	600K
5	SZ2	600K
6	SZ4	600K
7	SZ6	600K
8	SZ7	600K
9	SZ8	600K
10	SZ9	600K
11	ΣSSF	6000K
12	ΣSS	1500K
13	SZ10	600K
14	NSP	600K
15	ESP	600K
16	WWV	---

DATA GROUP 5078

Channel	Trace	Mag.
1	V	2K
2	MS1	0.75μb/mm
3	MS2	0.75μb/mm
4	DH6	---
5	DH5	---
6	DH4	---
7	DH3	---
8	DH2	---
9	DH1	---
10	ΣDHF	---
11	ΣDH	---
12	SZ1	
13	USO-SP	---
14	USO-Time	---
15	W1 (3 mph = 1 mm; S = 0/8 mm (E = 6 mm))	
16	WWV	---

DATA GROUP 5076

Channel	Trace	Mag.
1	SZ10L	60K
2	NSPL	60K
3	ESPL	60K
4	Z10LL	5K
5	NSPLL	5K
6	ESPLL	5K
7	SZ1	600K
8	SZ3	600K
9	SZ5	600K
10	ΣSSF	6000K
11	ΣSS	1500K
12	Z10	600K
13	NSP	600K
14	ESP	600K
15	TCDMG (Tape #1)	---
16	WWV	---

SLOW SPEED 3mm/min.

DATA GROUP 5074

Channel	Trace	Mag.
1	W1 (3 mph = 1 mm; S = 0/8 mm (E = 6 mm))	
2	SZ2	300K
3	ZLP1	25K
4	NLP1	25K
5	ELP1	25K
6	ZLP2	100K
7	NLP2	100K
8	ELP2	100K
9	ML1	3μb/mm
10	ML2	3μb/mm
11	USO - LP -	
12	ZBB	1.0K
13	NBB	1.0K
14	EBB	1.0K
15	WWV	
16	-----	----

LI TEST

Channel	Trace	Mag.
1	Triax 1	---
2	Triax 2	---
3	Triax 3	---
4	ML2	---
5	ZLP2	---
6	ZCT	---
7	NLP2	---
8	NCT	---
9	ELP2	---
10	ECT	---
11	W1 (3 mph = 1 mm; S = 0/8 mm (E = 6 mm))	
12	---	
13	---	
14	---	
15	---	
16	---	

MAGNETIC TAPE RECORDERS

DATA GROUP 5043 No. 1

Channel	Trace
1	TCDMG
2	ZBB
3	NBB
4	EBB
5	NSP
6	ESP
7	Comp.
8	USO-ZSP
9	USO-ZLP
10	USO-Time
11	Z10LL
12	NSPLL
13	ESPLL
14	WWV & Voice

DATA GROUP 5047 No. 2

Channel	Trace
1	TCDMG
2	Triax 1
3	Triax 2
4	Triax 3
5	W1
6	ML2
7	Comp.
8	ZLP1
9	NLP1
10	ELP1
11	ZLP2
12	NLP2
13	ELP2
14	WWV & Voice

DATA GROUP 5025 No. 3

Channel	Trace
1	TCDMG
2	SZ1
3	SZ2
4	SZ3
5	SZ4
6	SZ5
7	Comp.
8	SZ6
9	SZ7
10	SZ8
11	SZ9
12	SZ10
13	ΣSS
14	WWV & Voice

DATA GROUP 5045 No. 4

Channel	Trace
1	TCDMG
2	DH1
3	DH2
4	DH3
5	DH4
6	DH5
7	Comp.
8	DH6
9	ΣDH
10	ΣDHF
11	SZ1
12	ΣSS
13	ΣSSF
14	WWV & Voice

Table 4. Key to the designations used in the data format assignments at UBSO

Z	Amplified vertical short-period seismograph from a surface site identified by a suffix number	ELP2	East-west long-period seismograph, narrow response
SZ	Amplified vertical short-period seismograph from a shallow-buried site identified by a suffix number	ZBB	Vertical broad-band seismograph
NSP	Amplified north-south short-period seismograph	EBB	East-west broad-band seismograph
ESP	Amplified east-west short-period seismograph	ΣSS	Summation of SZ1 through SZ10
V	Unamplified vertical short-period seismograph	ΣSSF	ΣSS filtered
ZLP1	Vertical long-period seismograph, broad response	ML1	Long-period microbarograph (inside LP vault)
NLP1	North-south long-period seismograph, broad response	ML2	Long-period microbarograph (outside LP vault)
ELP1	East-west long-period seismograph, broad response	MS1	Short-period microbarograph (inside LP vault)
ZLP2	Vertical long-period seismograph, narrow response	MS2	Short-period microbarograph (outside LP vault)
NLP2	North-south long-period seismograph, narrow response	WWV	Radio time (WWV, STS, and voice on tape)
Mag.	Magnification (see note)	Test	Test instrumentation
TCDMG	Time code data management group	Comp	Wow and flutter compensation
		USO-LP	Unmanned seismological observatory long-period seismograph

Table 4, Continued

WI	Anemometer-wind speed and direction	ZCT	Coordinate transform of Triax 1, Triax 2, Triax 3 (vertical)
ECT	Coordinate transform of Triax 1, Triax 2, Triax 3 (east)	DH	Vertical array short-period seismograph
USO-SP	Unmanned seismological observatory short-period seismograph	ΣDH	Summation of DH1, DH2, DH3, DH4, DH5, and DH6
Triax	Experimental 3-component long-period seismograph	ΣDHF	ΣDH filtered
ΣTraix	Summation of Triax 1, Triax 2, and Triax 3	NCT	Coordinate transform of Triax 1, Triax 2, Triax 3 (north)

NOTE

Magnification of short-period measured at 1 cps; broad band measured at 0.8 cps; long-period measured at 0.04 cps.

3. EVALUATE DATA AND PROVIDE MOST EFFECTIVE OBSERVATORY POSSIBLE

3.1 REVISION OF OPERATING MAGNIFICATION OF LP2 SEISMOGRAMS

At the request of the Project Officer, the operating magnification of the LP2 seismographs as recorded on the primary long-period Develocorder was increased from 50K to 100K at 0.04 cps. The operating magnification of the LP2 system had been reduced 6 dB to provide data channels for direct comparison with the long-period triaxial seismograph outputs which are recorded on a separate Develocorder.

3.2 ADDITIONS TO INSTRUMENTATION AT UBSO

3.2.1 Vertical Array

Installation of the vertical array seismometers was completed on 7 February. System check-out was completed on 8 February, and the installation team returned to our Garland laboratory. On 10 February, when motor constant determinations were being made, the weight-lift calibrator for the DH2 element failed to operate properly. Because the DH2 seismometer had not required servicing during the installation of the array, we decided to use the motor constant used through 15 April 1967, and to verify the value indirectly by comparing P-phase amplitudes recorded on the DH seismographs.

When the routine calibration of the vertical array seismographs was attempted on 20 February, we were unable to switch the circuits to the calibrate position from the operate position. Circuit switching is accomplished by means of remotely-controlled motor-driven switches (whistles) with which any of several circuit combinations can be selected. Two whistles are required for each string of three seismometers to allow selection of each of the necessary functions (e.g., calibration, holelock activation, and normal operating configuration). Because the top whistle was inoperative, we were unable to switch control to the lower whistle; therefore, none of the instruments could be calibrated. On 26 February, the installation crew returned to UBSO, and removal and repair of the instruments were started on 28 February. All of the seismometers were removed from the hole by 5 March. Recovery of the seismometers was slow because the extended holelock of the DH5 instrument repeatedly became entangled in the cable of the lower string of seismometers. The seismometers were serviced and tested in the top of the hole before they were reinstalled at their normal operating depths.

To expedite reinstallation of the lower string of seismometers, a seismometer from the upper string and the DH2 seismometer were interchanged. The lower string was set in place on 19 March; however, because of a rapid decrease in the leakage-to-ground resistance in the DH1 circuit from 75 ohms to 5 ohms, it was necessary to remove the seismometers and to service the top DH3 connector. When the instruments were installed, an open circuit developed in a pin connection of the upper connector, and the seismometers were again removed from the hole. After repair, the lower string of seismometers was again placed in the hole. When we attempted to determine the calibrator motor constant on DH3,

we discovered that the weight-lift mechanism was inoperative. In addition, the lower whistle motor would operate only when excessive voltage was applied. On 1 April, the program manager decided to proceed with the installation of the upper string of seismometers and use the old calibration motor constant for DH3. By the end of 3 April, the top string of seismometers had been placed in the hole and the calibration motor constants determined. The seismometers operated satisfactorily throughout the remainder of the reporting period; however, because of frequent trouble with the lower whistle motor in the lower string of seismometers, we changed our calibration schedule from daily to weekly beginning with the week of 22 April.

3.2.2 Long-Period Array

The U. S. Corps of Engineers lease application for the LP4 (Vernal NE) site was approved by the Utah State Land Board at the monthly meeting on 20 March. The UBSO station manager was notified by Mrs. L. A. Logan of the Bureau of Indian Affairs on 26 March that the Ute Tribal Business Council had granted a temporary permit for use of the LP6 (Ft. Duchesne) site, subject to execution of the lease. The land use permit allowed construction of the sites to begin as scheduled on 8 April. The lease application for LP6 is still pending.

Work on the long-period array installation progressed at a satisfactory rate during the reporting period. All seismometers were delivered to our Garland-based support group and were subsequently shipped to UBSO; the mass-position monitor equipment was installed; the Model 23404 summation module was delivered; and the required additional Develocorder was modified.

During March, the digital tape recorder was delivered, and the required data control modules were obtained. On 5 March, a mobile telephone was installed in one of the vehicles to provide voice communications with the long-period field installations. We plan to obtain a second mobile telephone later for use during the check-out phases of the long-period array tasks.

Bids for fabricaton of the vaults, drilling of the holes, installation of the vaults, cementing of the vaults, and construction of the piers were requested from eight firms on 8 February. The requests for bids were written to allow bidders to bid on all or any part of the job. On 20 February, the contract for construction and installation of the vaults was awarded to the American Gilsonite Company, the low bidder. Bids were received from all of the firms solicited, and the low bid was about 26 percent below the next highest bid and about 43 percent below the highest bid.

The road and site construction for sites LP3 (Jensen), LP4 (Vernal NE), and LP5 (Little Mountain) was completed on 4 April, and construction on LP6 was completed on 8 April. Drilling began on 8 April at the LP3 site and was completed at this site in about 3 hours. Figure 3 shows the crew drilling the hole.

The drilling crew then set the casing in the hole, oriented the casing and floor forms, and poured the floor slab. Figure 4 shows the casing prior to insertion in the hole. On 9 April, another crew cemented the outside of the casing and poured the pier. This general procedure was followed at the LP1,

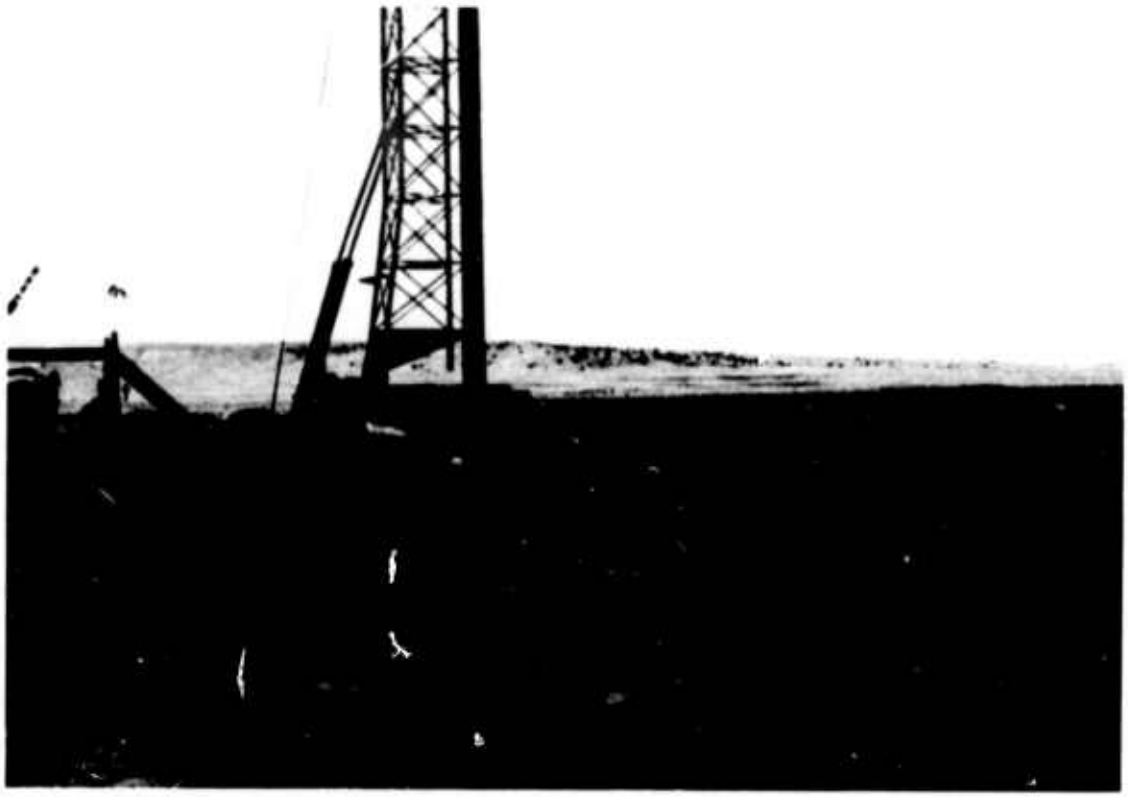

Figure 3. Drilling rig active in construction of a long-period vault site at UBSO G 4128

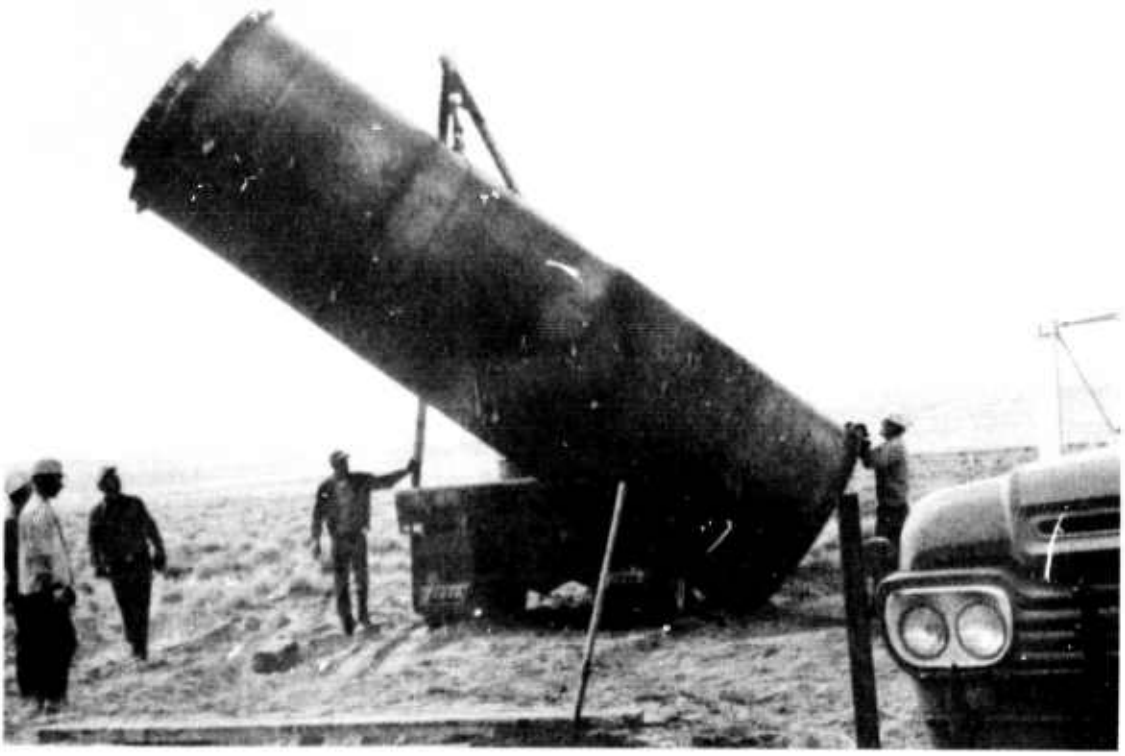

Figure 4. Long-period vault casing prior to installation at UBSO G 4129

LP2, LP4, LP5, and LP6 sites, although blasting was required at LP2, LP5, and LP6. The drilling and cementing at all 6 sites had been completed by 19 April. Figure 5 shows a typical site before cementing the vault and figure 6 shows the site after completion of the installation. Figure 7 shows the location of each of the long-period sites.

At the close of the reporting period, we were waiting to receive hardware for the lighting and power facilities. All remaining welding will be done when these materials are received.

During April, contracts were let to the Moon Lake Electric Company and Uintah Power and Light Company to supply power to 5 of the 6 long-period vaults and with the Mountain States Telephone Company to provide transmission lines from the long-period sites to Vernal and from Vernal to the UBSO Central Recording Building (CRB). At five of the long-period sites, Moon Lake Electric and Uintah Power and Light will provide a 3 kVA transformer at a minimum distance of 100 feet from the vault (see figure 8). The transformers will supply 115 volts to the breaker box, from which 110 volts will be carried by underground conduit to the vault. Power will be supplied to the LP5 site by a thermoelectric generator. The telephone company will supply transmission lines to within a minimum distance of 100 feet of each vault. An underground conduit will connect the vault to the telephone line termination (see figure 8).

The manufacturing phase for Digital Field Station No. 1 (DFS No. 1) and the Central Digital Station (CDS) of the UBSO Digital Acquisition System was about 90 percent complete at the close of the reporting period. Figure 9 is a view of the CDS showing the supervisory control panel and the digital tape unit; figure 10 is a rear view of the CDS showing the two file card doors. Figure 11 is a view of the DFS No. 1 with the file card door exposed.

System check-out of the CDS and DFS No. 1 and mechanical assembly of the remaining six field stations will begin early in May. Complete assembly and check-out of all systems are scheduled to be completed by mid-July 1968. Figure 12 shows the time schedule for the project.

3.2.3 Shallow-Buried Array

In February, five 50,000-ohm potentiometers were installed in the shallow-buried array calibration unit to provide additional attenuation control for all seismographs recorded on magnetic tape. These modifications were necessitated by the revised calibration procedures adopted in December 1967. The balance of the required attenuators was delivered to UBSO late in April and will be installed early in May. These potentiometers provide up to 14 dB attenuation.

3.3 REMOVAL OF MAP I

During March, the MAP I unit and the associated wiring in the CRB were removed, and the MAP I unit was returned to our Garland, Texas, warehouse for storage.

Figure 5. Long-period vault prior to cementing G 4130

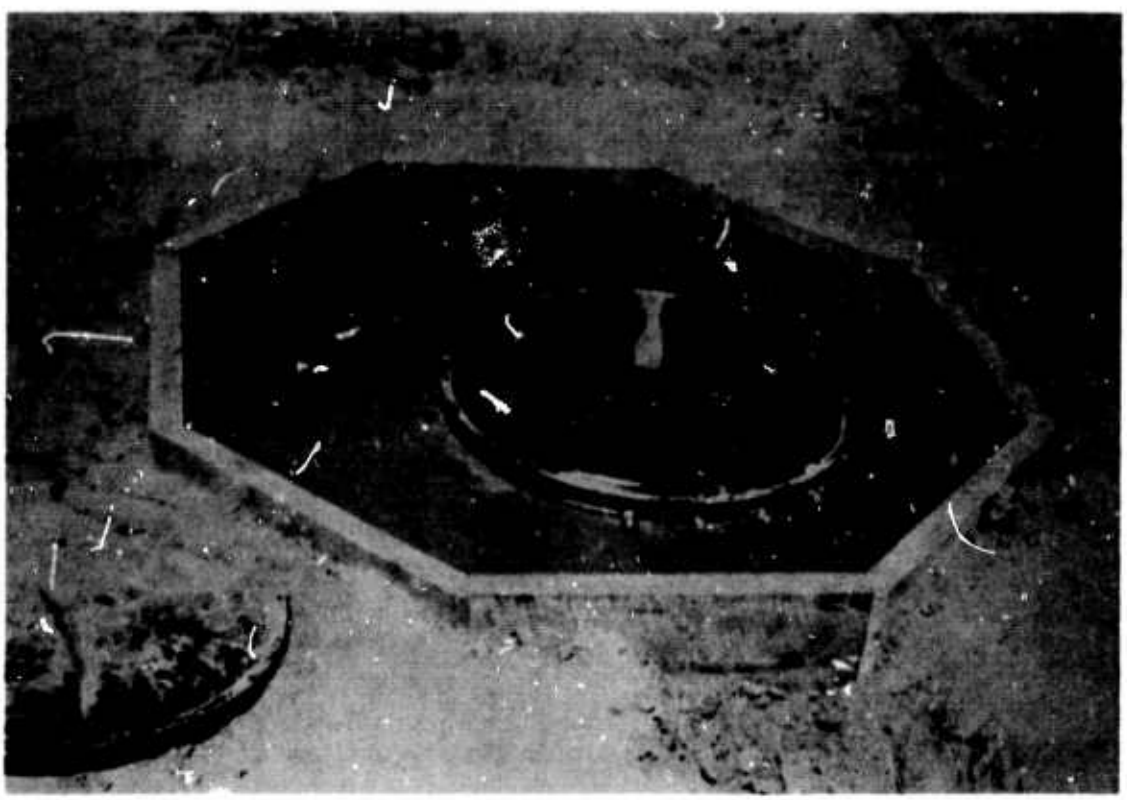

Figure 6. A typical long-period site at UBSO after completion of the vault installation G 4131

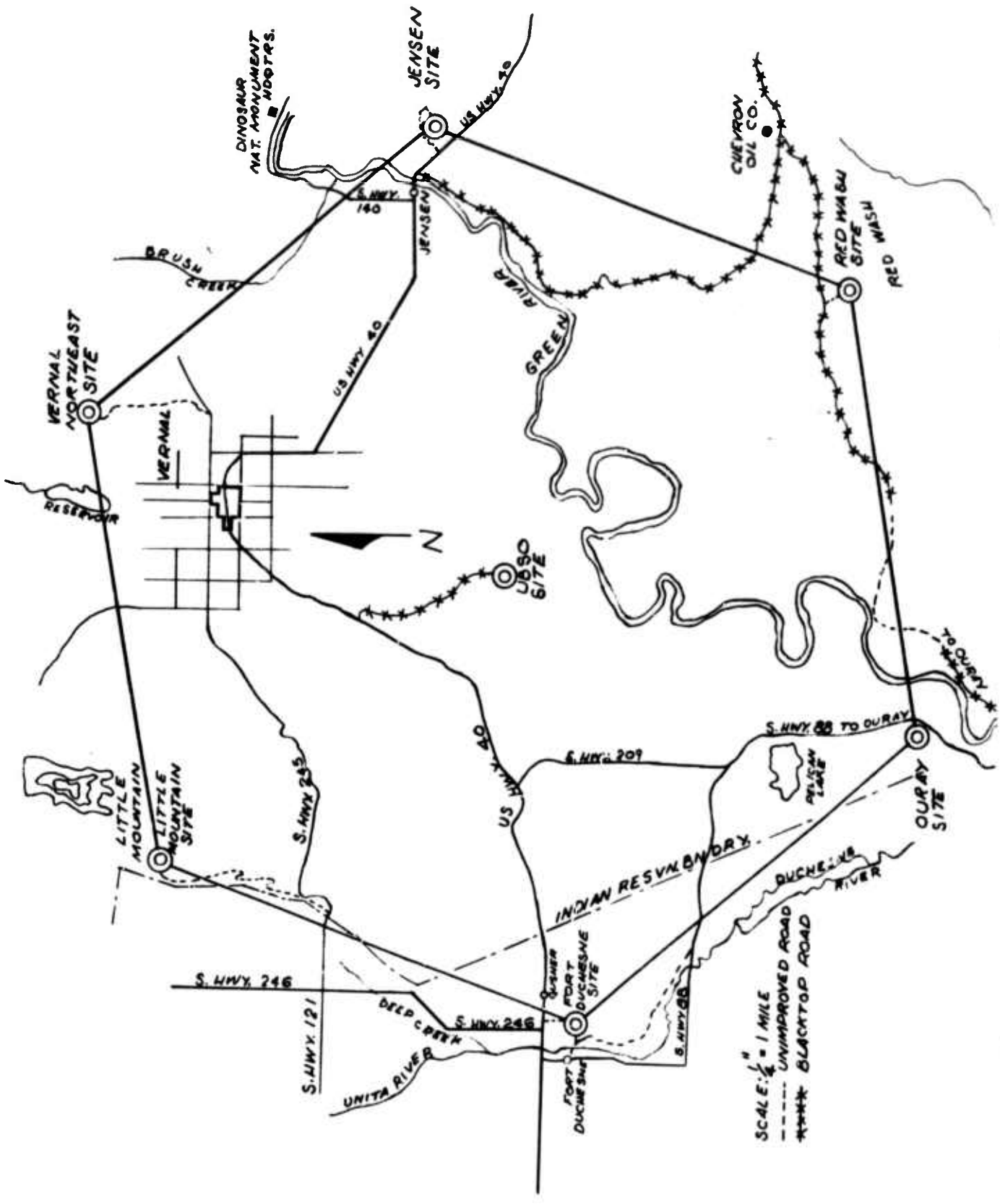

Figure 7. LP array shown in relation to main access routes and local landmarks

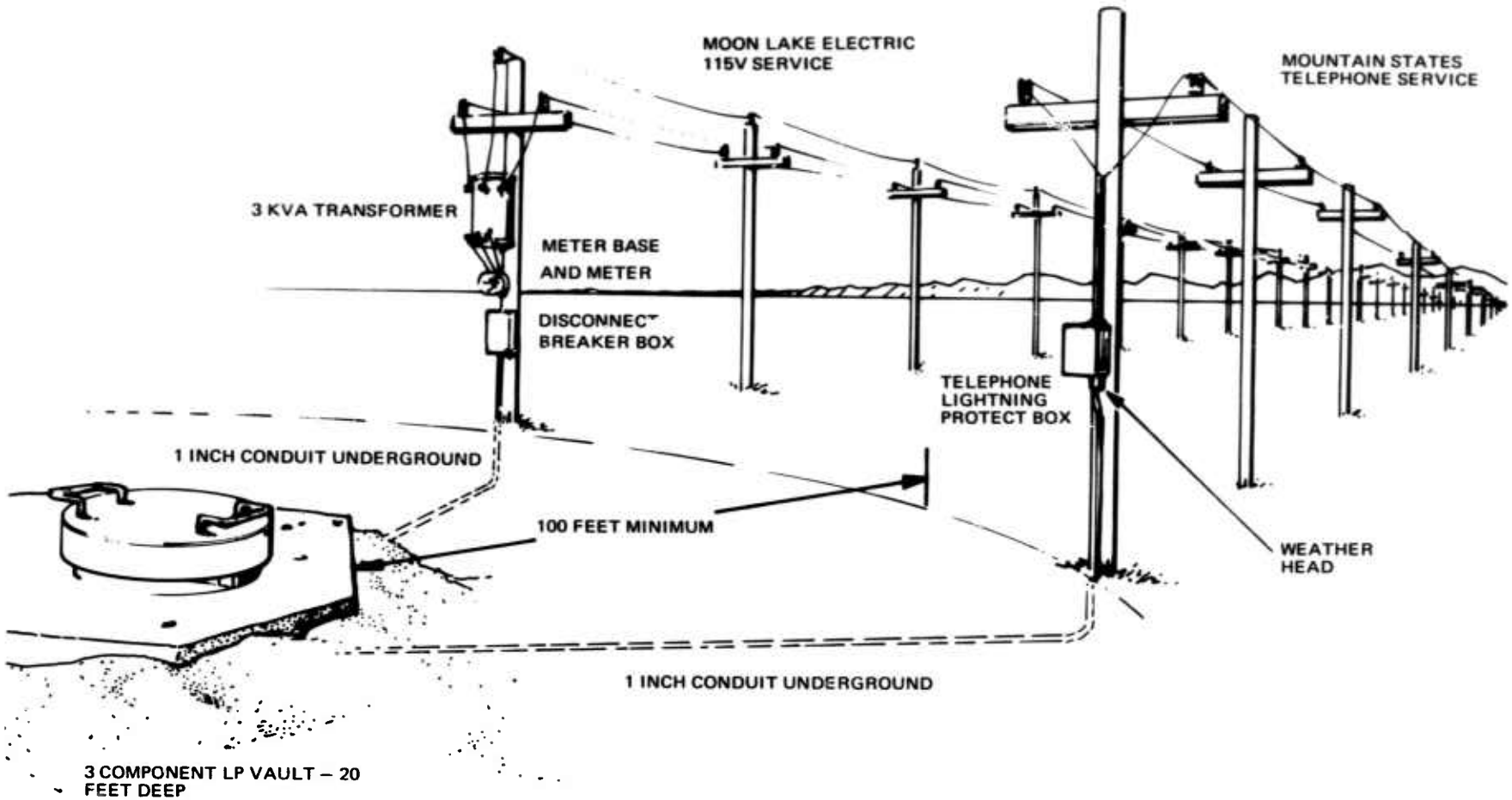

Figure 8. Diagram showing the planned access to a long-period vault of commercial power and telephone service

G 4132

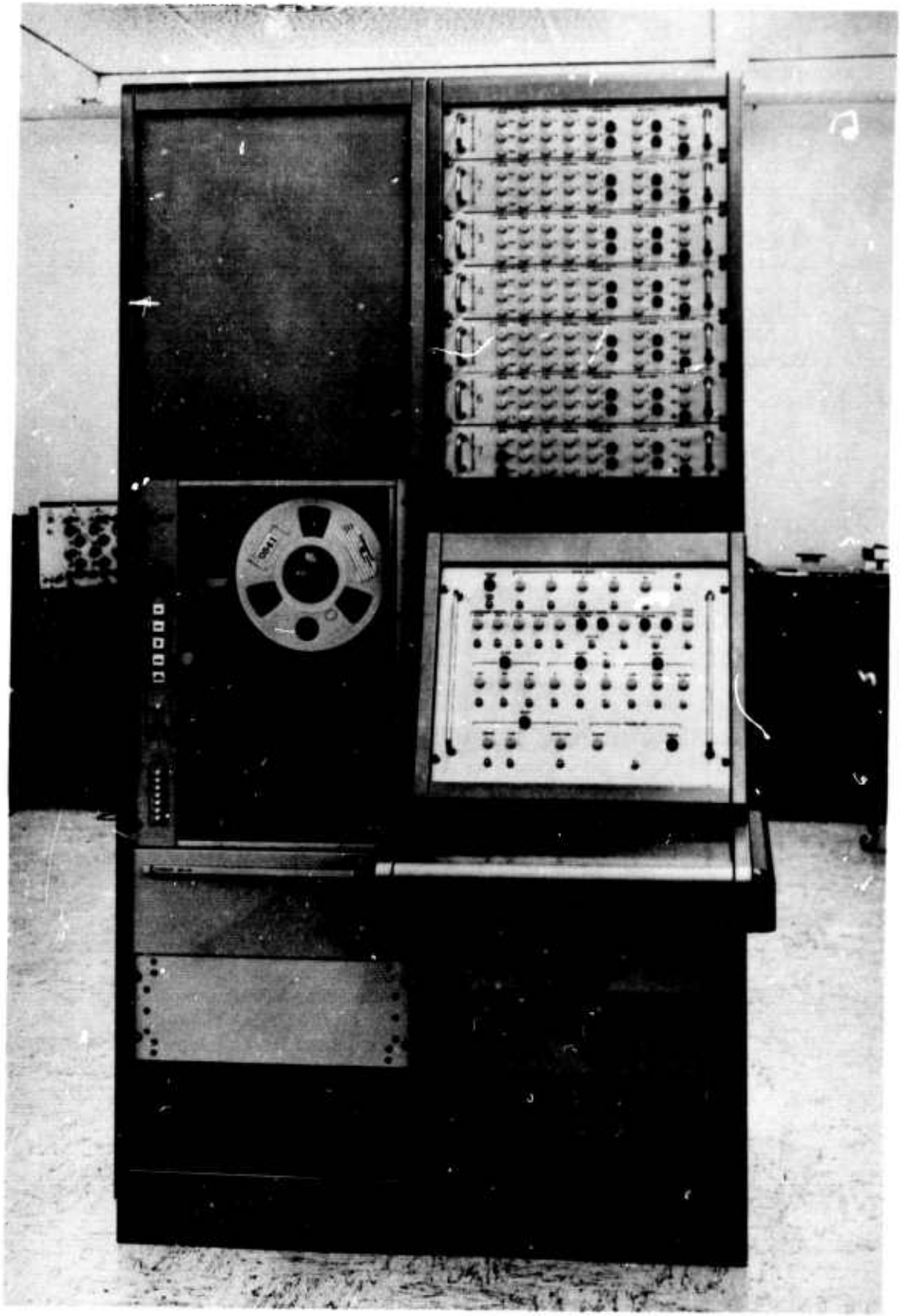

Figure 9. Central Digital Station showing the supervisory control panel and the digital tape unit

G 4133

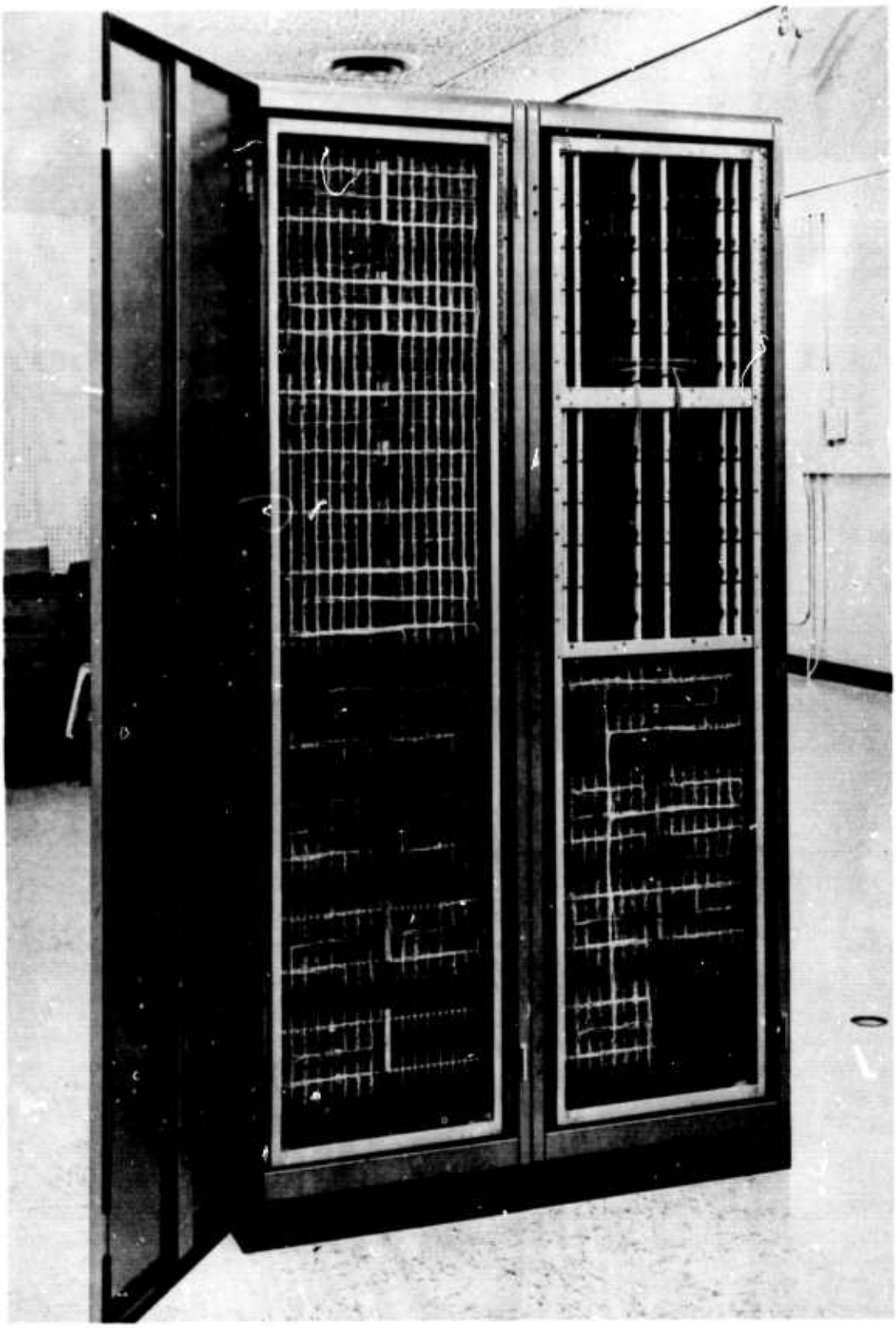

Figure 10. Rear view of the Central Digital Station showing the two file card doors

G 4134

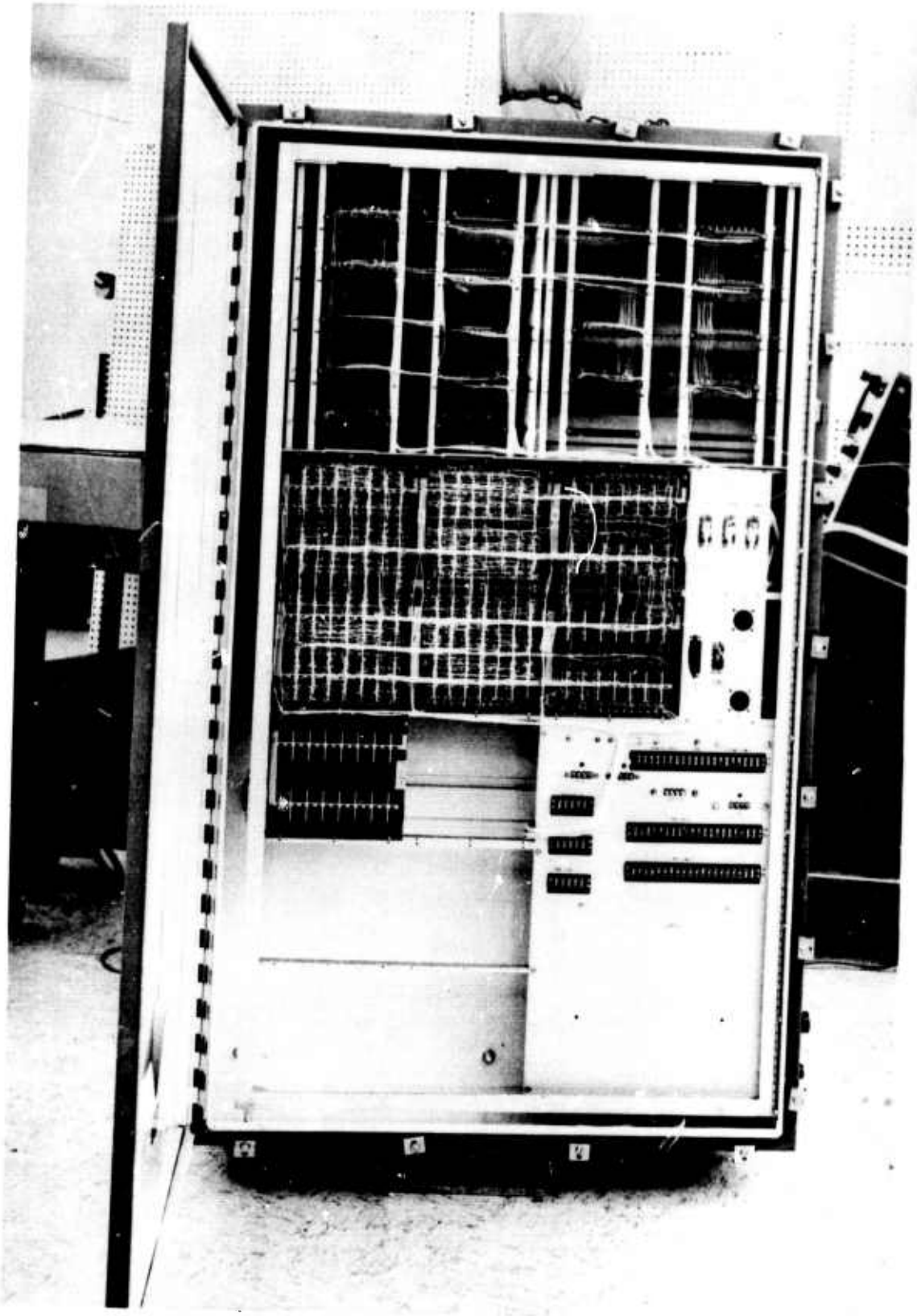

Figure 11. View of a Digital Field Station with the file card door exposed

G 4135

UBSO		APRIL		MAY				JUNE				JULY	
		22-26	29-3	6-10	13-17	20-24	27-31	3-7	10-14	17-21	24-28	1-5	8-12
LOGIC DESIGN													
A. CDS	Complete												
B. DFS	Complete												
C. Communication	Complete												
D. Test set - CDS	Complete												
E. Test set - DFS	Complete												
PACKAGING													
A. CDS	Complete												
B. DFS	Complete												
POINT-TO-POINT													
A. DFS	Complete												
B. CDS	Complete												
C. Test set - CDS	Complete												
D. Test set - DFS	Complete												
ASSEMBLY AND TEST													
A. CDS													
B. DFS No. 1													
C. DFS No. 2													
D. DFS No. 3													
E. DFS No. 4													
F. DFS No. 5													
G. DFS No. 6													
H. DFS No. 7													

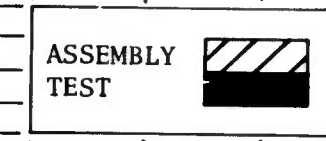

Figure 12. Time schedule for the completion of the Digital Acquisition System for UBSO

3.4 REVISION OF LONG-PERIOD FREQUENCY RESPONSES

Effective with the March 1968 long-period frequency response, we discontinued calibration at 0.143 cps. The calibration data at this frequency were of no value in maintaining the response of the long-period instruments because the low response of the seismograph systems at 0.143 cps resulted in unreadable or unreliable records.

To assure uniformity of long-period system responses from month to month, we established new norms and tolerances (see table 2) in April. The norms were based on the average of the responses measured for the 4 months of August through November 1967. These operating parameters are interim values for use until the long-period array seismographs are operational. When the array elements are activated, the UBSO long-period frequency response parameters will be matched to those used for the TFSO long-period seismographs.

4. TRANSMIT DAILY MESSAGES TO THE COAST AND GEODETIC SURVEY

The arrival time, period, and amplitude measurements for events recorded at UBSO were reported daily to the Director of the Coast and Geodetic Survey in Washington, D. C. The number of events, by type, reported by UBSO during each month in this reporting period is shown in table 5. Table 6 shows the total number of events recorded by the observatory; the number of epicenters determined by the C&GS and reported in the "Earthquake Data Report"; the percent of the C&GS hypocenters for which the C&GS report listed a UBSO P or PKP phase; the percent of C&GS hypocenters for which UBSO recorded a P or PKP phase, as determined from associated data; and the percent of C&GS hypocenters for which UBSO recorded a P, PKP, or later phase, based on updated associated data for November and December 1967. Lists of more recent epicenters have not been completed by the C&GS.

Figures 13 and 14 show the world-wide distribution of the C&GS-located epicenters for October, November, and December 1967. The three types of symbols used to show the locations of the epicenters represent the detection by UBSO of a P or PKP, the detection of an event in which the first recorded arrival was not P or PKP, and no detection.

5. PUBLISH MONTHLY EARTHQUAKE BULLETIN

Data from UBSO were combined with data from BMSO, CPSO, TFSO, and WMSO and published in a multistation earthquake bulletin. The bulletins for October and November 1967 were published and distributed during the reporting period. The ABP output for the December 1967 bulletin was received from the Seismic Data Laboratory on 9 April, and the December bulletin is scheduled for distribution about 17 May 1968.

Table 5. Events reported to the C&GS by UBSO during February, March, and April 1968

Month	Local	Near regional	Regional	Teleseisms	Total
February	15	409	24	967	1415
March	19	377	22	836	1254
April	5	318	109	1136	1568

Table 6. Percentage of hypocenters reported in the C&GS "Earthquake Data Report" for which UBSO data were used

Month	No. events reported by UBSO	No. C&GS hypocenters	Percent of C&GS hypocenters for which the C&GS listed a UBSO P or PKP arrival	Percent of C&GS hypocenters for which UBSO recorded a P or PKP phase, based on associated data	Percent of C&GS hypocenters for which UBSO recorded a P, PKP, or later phase, based on updated associated data
November	1432	390	55.1	71.2	76.3
December	1199	379	53.6	67.7	73.0

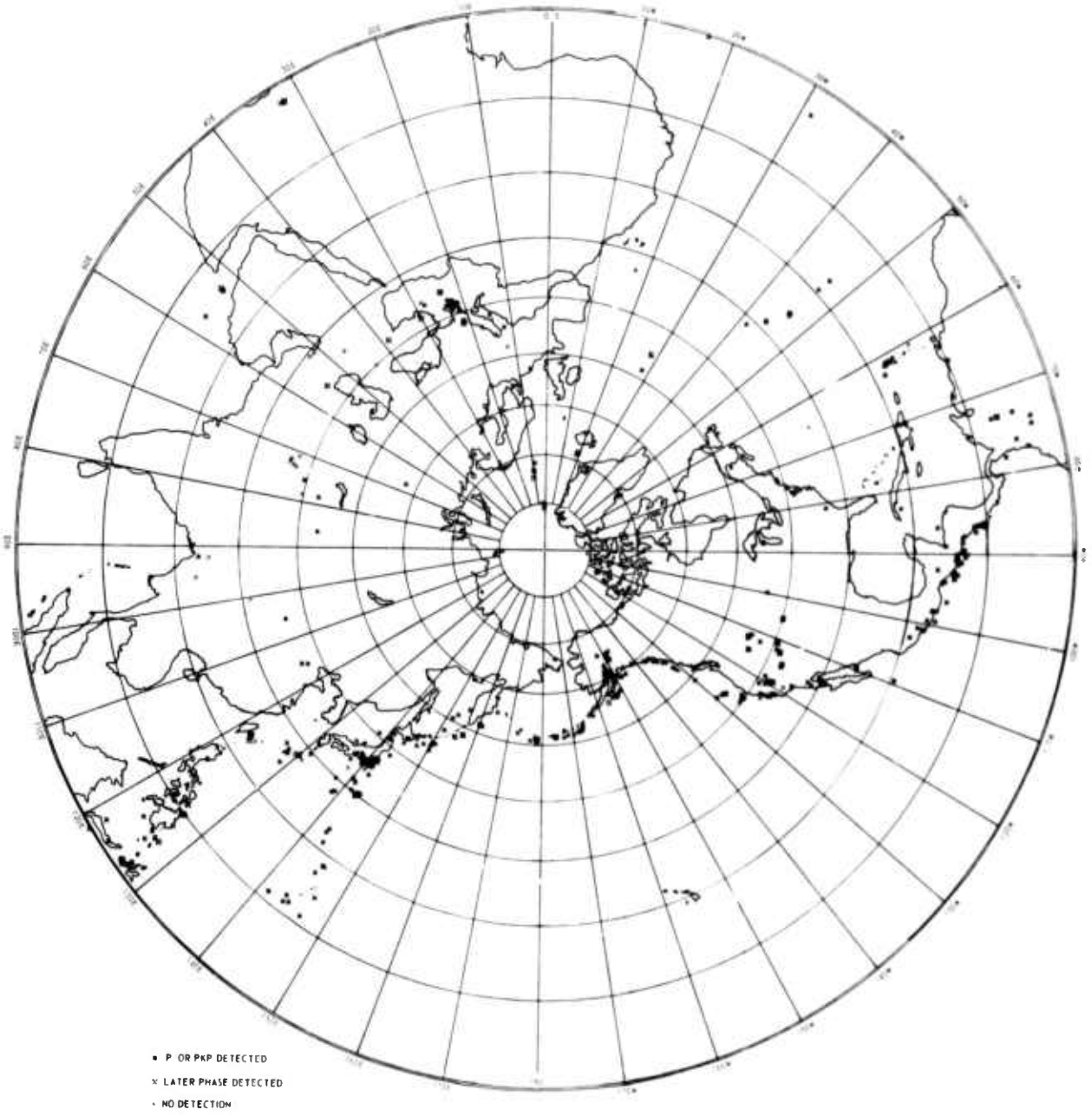

Figure 13. Distribution of Coast and Geodetic Survey located epicenters in the northern hemisphere for October, November, and December 1967

G 3179

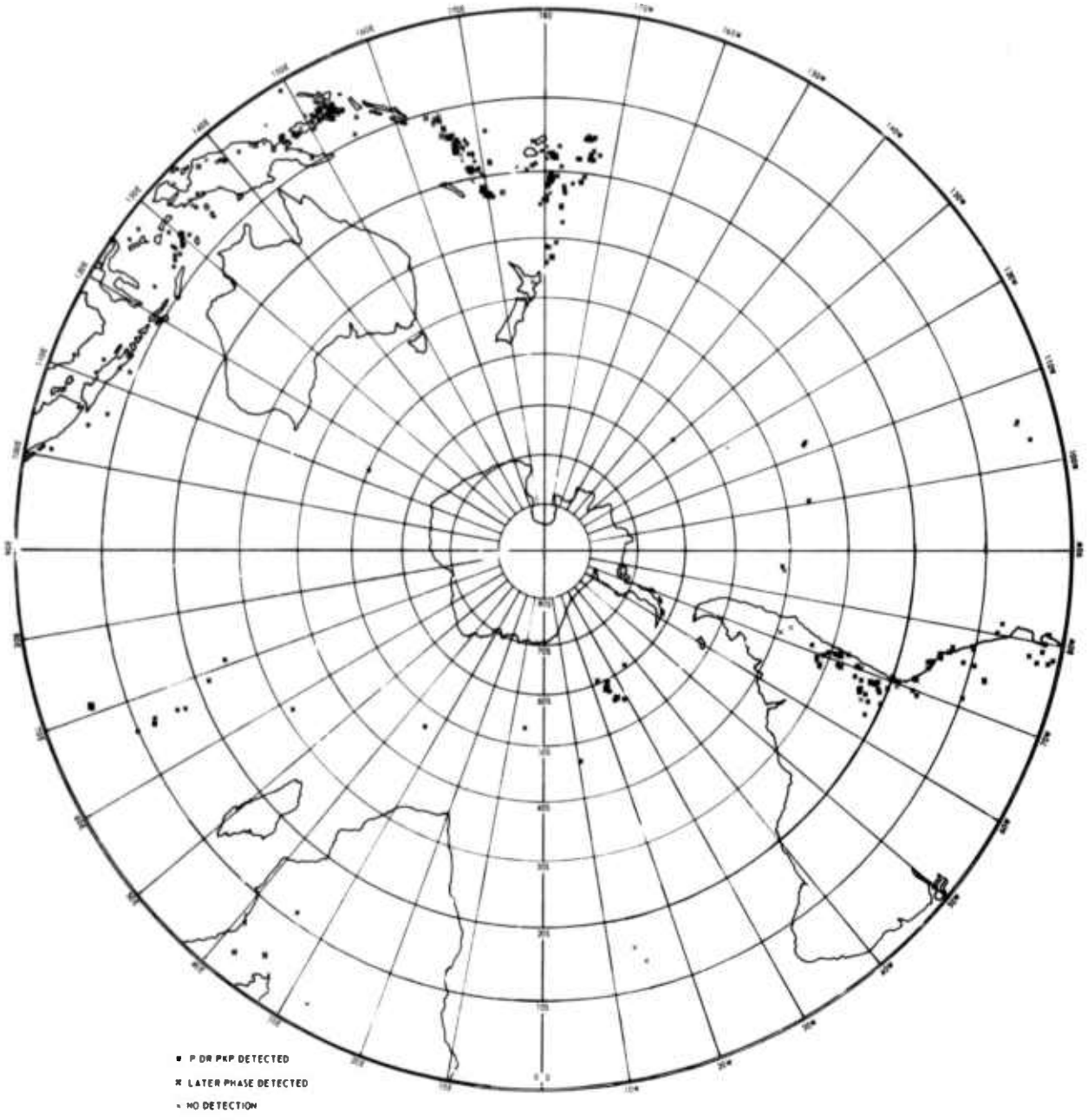

Figure 14. Distribution of Coast and Geodetic Survey located epicenters in the southern hemisphere for October, November, and December 1967

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6. MAINTAIN UBSO FACILITIES

The annual inventory of Government equipment was completed at UBSO on 23 February. The data were mailed to the Geotech property control group where they were checked and reported to the Government property officer.

7. EVALUATION OF THE VERTICAL ARRAY

Approximately 1 month of vertical array data was obtained during the reporting period. Evaluation of the vertical array will be resumed in May on these and subsequent data.

8. ROUTINE NOISE MEASUREMENTS

Measurements of ambient noise in the 0.4- to 1.4-seconds period range are made daily at UBSO. Data are processed in Garland, and monthly cumulative probability curves of trace amplitude and ground displacement data are published. Noise data are reported from the SZ10, ΣSS, and ΣSSF seismograms. Noise curves for January and February 1968 were sent to the Project Officer during this reporting period.

9. PROVIDE OBSERVATORY FACILITIES AND ASSISTANCE TO OTHER ORGANIZATIONS

9.1 LONG-PERIOD TRIAXIAL SEISMOGRAPH

The outputs of the triaxial seismograph system were recorded on Develocorder, Helicorder, and magnetic-tape recorder throughout the reporting period. UBSO personnel continued to provide maintenance and supervisory support for the triaxial seismograph program.

9.2 TECHNICAL ASSISTANCE AND MONITORING OF SANDIA'S UNMANNED SEISMOLOGICAL OBSERVATORY (USO)

We continued to monitor the outputs from the USO and report the results to Sandia Corporation through 23 April. Sandia personnel were at UBSO on 24 and 25 April to deactivate the USO and pack it for shipment to Albuquerque. The thermoelectric generator used with the USO was retained at UBSO for use in the long-period array.

9.3 DATA SENT TO THE UNIVERSITY OF UTAH

The weekly summary of local and near regional events was furnished throughout the reporting period to the University of Utah.

10. REPORTS

a. Technical Report No. 67-75, Evaluation of Multiple Array Processors at the Uinta Basin Seismological Observatory, was mailed to the Project Officer on 8 February 1968.

b. Technical Report No. 68-13, Operation of the Uinta Basin Seismological Observatory, Quarterly Report No. 7, 1 November 1967, through 31 January 1968, was mailed to the Project Officer on 28 March 1968.

APPENDIX to TECHNICAL REPORT NC. 68-23

STATEMENT OF WORK TO BE DONE

EXHIBIT "A"

STATEMENT OF WORK TO BE DONE

AFTAC Project Authorization No. VELA ~/6705/S/ASD (32)

1. Tasks: 8 February 1966

a. Operation:

(1) Continue operation of the Uinta Basin Seismological Observatory (UBSO), normally recording data continuously.

(2) Evaluate the seismic data to determine optimum operational characteristics and make changes in the operating parameters as may be required to provide the most effective observatory possible. Addition and modification of instrumentation are within the scope of work. However, such instrument modifications and additions, data evaluation, and major parameter changes are subject to the prior approval of AFTAC.

(3) Conduct daily analysis of seismic data at the observatory and transmit daily seismic reports to the US Coast and Geodetic Survey, Wash DC 20230, using the established report format and detailed instructions.

(4) Record the results of daily analysis on magnetic tape in a format compatible with the automated bulletin program used by the Seismic Data Laboratory (SDL) in their preparation of the seismological bulletin of the VELA-UNIFORM seismological observatories. The format should be established by coordination with SDL through AFTAC. The schedule of routine shipments of these prepared magnetic tapes to SDL will be established by AFTAC.

(5) Establish quality control procedures and conduct quality control, as necessary, to assure the recording of high quality data on both magnetic tape and film. Past experience indicated that quality control review of one magnetic tape per magnetic tape recorder at the observatory each week is satisfactory unless quality control tolerances have been exceeded and the necessity of additional quality control arises. Quality control of magnetic tape should include, but need not necessarily be limited to, the following items:

(a) Completeness and accuracy of operation logs.

(b) Accuracy of observatory measurements of system noise and equivalent ground motion.

(c) Quality and completeness of voice comments.

(d) Examination of all calibrations to assure that clipping does not occur.

(e) Determination of relative phase shift on all array seismographs.

(f) Measurement of DC unbalance.

(g) Presence and accuracy of tape calibration and alignment.

(h) Check of uncompensated noise on each channel.

(i) Check of uncompensated signal-to-noise of channel 7.

(j) Check of general strength and quality of timing data derived from National Bureau of Standards Station WWV.

(k) Check of time pulse modulated 60 cps on channel 14 for adequate signal level and for presence of time pulses.

(l) Check of synchronization of digital time encoder with WWV.

(6) Provide observatory facilities, accompanying technical assistance by observatory personnel, and seismological data to requesting organizations and individuals after approval by AFTAC.

(7) Maintain, repair, protect, and preserve the facilities of the seismological observatory in good physical condition in accordance with sound industrial practice.

b. Instrument Evaluation: After approval by AFTAC, evaluate the performance characteristics of experimental or off-the-shelf equipment offering potential improvement in the performance of observatory seismograph systems. Operation and test of such instrumentation under field conditions should normally be preceded by laboratory test and evaluation.

c. Special Investigations: Conduct research investigations as approved or requested by AFTAC to obtain fundamental information which will lead to improvements in the detection capability of UBSO. These programs should take advantage of geological, meteorological, and seismological conditions at UBSO. The following special studies should be accomplished.

(1) Long term evaluation of the multiple array processor units.

(2) Installation and evaluation of a vertical array.

(3) Evaluation of the long-period vault.

(4) Provide technical assistance and monitor an unattended seismological observatory to be installed at UBSO in June 1967.

Research might pursue investigations in, but is not necessarily limited to, the following areas of interest: microseismic noise, signal characteristics, data presentation, detection threshold, and array design (surface and shallow borehole). Prior to commencing any research

investigation, AFTAC approval of the proposed investigation and of a comprehensive program outline of the intended research must be obtained.

2. Approval by AFTAC will normally be provided through the project officer.

3. Reports: Provide reports in accordance with the Data requirements outlined in DD Form 1423 and attachment 1 thereto.

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10. DISTRIBUTION STATEMENT
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11. SUPPLEMENTARY NOTES

12. SPONSORING MILITARY ACTIVITY
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Washington, D. C.

13. ABSTRACT

This report describes the operation of the Uinta Basin Seismological Observatory (UBSO) from 1 February 1968 through 30 April 1968. Modifications and additions to the observatory instrumentation are described, and tests to improve the operations of the observatory are reported. Also discussed is the status of special investigations designed to evaluate and improve the detection capability of the observatory.

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14. KEY WORDS	LINK A		LINK B		LINK C	
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Vertical Array						
Long-Period Array						
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Seismograph Operating Parameters						